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Globalization—A Vision of a New World

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Globalization—A Vision of a New World

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In times of great or seismic change, there are great opportunities for those with the imagination and initiative to seize the moment and enable transformations. Often these opportunities seem too enormous, too threatening, and not in any context that may be within our zones of comfort. It is then that we tend to focus on achievable details, doing what we can to improve that which is readily within reach. This tendency can almost be likened to ‘polishing the doorknobs on the Titanic after hitting the iceberg!’

Globalization has many interpretations—it is blamed for many effects and it affects everything that we do. It has pervasive influence, is unavoidable, and cannot be changed. Given the context of the ‘increasingly flat’¹ world today, we must accept it and take advantage of it.

There are two interpretations of globalization. One is an internalized nationalistic notion that subscribes to ‘Ross Perot’s giant sucking sound’² that has stolen and continues to steal American

jobs. Then there is the optimistic opportunistic external view that brings increasing trade, changing economic conditions, leveling of competitive opportunities, cheaper, better supply chains etc. (sometimes not necessarily faster)—but is accompanied by dependencies arising from increased collaboration and possibly aggravated by more competition. This competition brings opportunities to small and medium-sized organizations (SMEs) that are skilled and responsive. There are several cases of successful small U.S. niche manufacturers that have been meeting global competition even in New York City.³

But right now we have the giant financial sucking sound all around us as levels of ‘value’ change drastically. Perhaps we need to start counting value in terms of carbon footprints, bottles of potable water, or access to adequate food supplies. How does all this affect our manufacturing academic community, aside from hitting our 401(k)s? We are all working, mostly tenured, and regularly may be busier than we would choose—but we are becoming an increasingly rare breed because ‘manufacturing’ has become a dirty word in the U.S. Elsewhere there is a tendency to call it ‘production.’ The newer faculty in many of our departments are skilled at developing algorithms, optimization tools for complex networks, and contemplating financial engineering together with theories of resource allocation and decision making; the idea of learning about processes is tending to be left to the Discovery Channel™, Google™, and Wikipedia.

I believe this is our collective fault. In the last few decades we have eschewed multiple opportunities for change and thus for altering the meaning and image of manufacturing. Shortsightedness and lack of enthusiasm for change are a human and a global problem that dominates the media today. All countries share the problems of global warming, declining fossil fuel supplies, energy, pollution, and transportation in varying degrees, and there are huge manufacturing (and investment) challenges in the competition to find solutions.

The National Academy of Engineering (NAE) in its 2020 vision mentioned the importance of an appreciation of social anthropology for engineers and scientists.⁴ Today this is more important than ever. What do I mean here? Although we are descended from collaborative hunters-gatherers, collaboration is not an intrinsic habit of individuals or groups today unless they are severely threatened. By nature, we cluster ourselves into affinity groups—our relations, neighborhood, departments, colleges, professional affiliations, companies, states, and nations have become ‘silos.’ We have a need not only for freedom and independence but also for belonging. It is important for career survival to ‘belong’ to the right group and to offer loyalty in return for safety. Any kind of change becomes a threat to security and stability, but change is unavoidable. We can duck but we cannot hide, unless we are particularly fortunate. We must stop espousing manufacturing as our specialized niche activity within engineering, when, in fact, in the world today, manufacturing taken overall as an area of human endeavor is the truly liberal art with potential to bring sources of comfort, prosperity, safety, and solace to the entire global community. It is worth rereading Adam Smith to see how long ago this was being recognized.⁵

Our solutions must be global, they must be collaborative. What are the educational regimes to accomplish equable and satisfactory globalization? What is a possible vision for the future? For a start, all of us in the academic community must leap out of our tenure-protected silos, our cubicles, and insist with vehemence that **ALL ENGINEERING IS ACTUALLY MANUFACTURING.**

Taken broadly and philosophically, engineering is about solving problems, designing, and making ‘stuff’ that satisfies human needs and concurrently generates wealth without trauma. This whole process cycle must be regarded as the core of manufacturing. We need to contemplate manufacturing not just as a process using lathes and milling machines—interesting as they are—but as a series of generic processes whereby atoms, molecules, and aggregates of materials and resources are integrated, divided, augmented, reacted, deposited, fermented, or otherwise transformed by all manner of processes into products that bring us revenue and satisfy global customers. All this must be accomplished in an essentially trauma-free, sustainable manner.

That old Society of Manufacturing Engineers list⁶ of key characteristics is still valid, but it needs to be read across all engineering disciplines and wedded to the NAE 2020 projection.⁴ Our curricula are constrained by accreditation, bureaucracy, and disciplinary subdivisions. All of the most interesting challenges and opportunities today involve cross or interdisciplinary processes. We must give our students ambiguous and unstructured assignments that force them to become empowered, innovative self-learners capable of comprehending the frontiers of their chosen sectors of knowledge. Overall, our academic and professional organizations tend to measure us for ‘teaching’ whereas what we should really be doing is guiding our students and empowering them to learn for themselves.

How can this be brought about on a global horizon? There have been many prestigious meetings and projects, mostly under the umbrella of specific discipline-focused groups but also by the international consortium for Intelligent Manufacturing Systems (IMS).⁷ There are several reports, and that initial effort is now struggling for funding for revitalization. Collaboration is difficult—or maybe that is my excuse, as my ideas are often perceived as too much, too soon, and somewhat ‘off the wall.’ I became the U.S. representative for the Global Education for Manufacturing (GEM) project and was inundated with bureaucracy, forms to fill out, and then invitations to events on a global scale. The instant a U.S. member was signed up, nearly all the representatives/participants/contributors from other countries and continents received funding. I was forced to use their funding to attend meetings, but one meeting was held at Lehigh University where I could fund my own travel! The GEM project didn’t exactly fail, and a successor project seems to be aborning, but it hasn’t been implemented with excitement and enthusiasm and e-mails go unanswered.

Nearly all the problems with globalization efforts stumble over acceptance of dependency and interpretation of exact meanings. Does ‘YES’ mean ‘I agree,’ or does it just signify that ‘I heard you’? Transnational industries are being successful globally, as are some smaller entrepreneurial operations; fully recognizing the facts of globalization and incorporating them into our academic endeavors is a challenge that lies before us. Our cross-disciplinary MS in MSE program at Lehigh provided a course that formed a part of General Motors-developed curricula at Kettering University, Purdue University, and the University of Michigan. This worked well for several years until other distractions impacted GM funding. I’m sure our Lehigh MSE distance students would welcome information on possibly collaborative electives that could be made available to them by other institutions (and globally).

What's the net?

1. We need to leave our silos and embrace the notion that all engineering is really manufacturing and that it is a global activity.
2. We must engender generic interpretations and notions of all the transformation processes that generate products (and even including data-rich 'products' such as financial instruments, insurance policies, mortgages, software, etc.). There is need for a 'process' focus for the whole life cycle from concept and design to customer satisfaction.
3. We should empower our students to appreciate and recognize global business trends, communication and cultural issues, engineering economics, and logistics, and to be capable of contributing and working in diverse teams.
4. Learning should not be such a prescriptive process, but it should be adapted to the informed needs of every student (and of their future employers).
5. We are all, like it or not, global citizens and we must accept our interdependence.

Thomas Friedman summed up the vision of the new (and exciting) world better than I dare to in an op-ed piece in the *New York Times* on October 19, 2008, talking about the financial crisis:

"I suspect we will soon see the same happening in industry. And, once the smoke clears, I suspect we will find ourselves living in a world of globalization on steroids—a world in which key global economies are more intimately tied together than ever before.

It will be a world in which America will not be able to scratch its ear, let alone roll over in bed, without thinking about the impact on other countries and economies. And it will be a world in which multilateral diplomacy and regulation will no longer be a choice. It will be a reality and a necessity. We are all partners now."

In conclusion, through this decade or so, the U.S. will likely remain the world's greatest consumer, the greatest and most rapidly responsive marketplace; additionally, we have the ability and systems to become the leaders in solving many of the problems that may presently seem dire. Collaboration, flexibility, imagination, and manufacturing ingenuity in response to the needs of global customers will to some extent level the economic playing fields, and there should be decent opportunities for all those countries and individuals with freedom, financially sound institutions, and solid educational foundations. Change must be embraced, and with enthusiasm, to survive, succeed, and share rising global prosperity and reduce poverty.

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5. Smith, Adam (1776). Many editions including, The wealth of nations. New York: Bantam Classics, 2003 reprint edition.
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Postscript

Some excellent questions after my dinner talk triggered some more thoughts. First, what I am suggesting will not necessarily be easy or comfortable. Global competition is intense and requires close attention and extraordinary diligence, effort, and focus; the mantra from ideas of ‘agility’ about collaborating to compete, understanding marketplaces, and maintaining ‘responsibility’ may have become clichés, but they are kernels of some valuable ideas.⁸

Collaborate does mean that we share technology; as was pointed out, a single dedicated manufacturing company doesn’t have the resources to develop, adapt, and exploit all of the newest technologies that may be required to implement many of the new and potential products. (The Dreamliner and A380 come to mind, but this is equally true in microelectronics, for firms that design circuits don’t any longer also design systems or the chemical and physical processes to realize those circuits. IBM collaborates and competes with Intel, with Microsoft, etc.)

If we just consider our economics and systems on a truly global scale, eventually, and on a timescale that may test our patience, there should be tendencies toward some global equilibrium. Ultimately, there should be a trend toward some global average for those countries with effective educational and financial systems and decent access to resources and markets; maybe this is an idealistic dream, but it should be a conceptual target. Our survival as a race, not necessarily as a nation (perhaps we need to tone down the emphasis on that silo!), depends on the equable development and sharing of a prosperity generated by manufacturing, trade, and adroitly balanced commerce. How this develops, spreads, and is shared to benefit the increasing numbers of the poorer members of both developed and underdeveloped communities is a puzzle that lies at the feet of the supranational organizations, and every developed nation.

The challenges of climate change, shortages of potable water, disease, and famine are grabbing the attention of our youth in my present classes. From an educational viewpoint, we need more adaptive and responsive curricula geared toward these challenges. Future curricula must adapt and change to address the needs of the future students and workforce.

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About the author

Keith Gardiner is the director of the Center for Manufacturing Systems Engineering and the associated cross-disciplinary MS in MSE program at Lehigh University; he is a professor of Industrial and Systems Engineering. His B.Sc. and Ph.D. degrees are in metallurgy from the University of Manchester, England (1953 and 1956). He spent 21 years with IBM in semiconductor manufacturing and with the Corporate Manufacturing Technology Institute. In the U.K. prior to this he worked on manufacturing methods for gas turbines with Rolls-Royce and on the development of nuclear fuel elements with English Electric. While with IBM he served as adjunct professor at the University of Vermont, 1974-80, IBM Faculty Loan Professor at Southern University, Louisiana, 1978-79, both appointments in mechanical engineering. During the period 1981-87 he was an adjunct in mechanical engineering at Binghamton University (SUNY). He is a registered professional engineer in the State of California (PE), a Certified Manufacturing Engineer, a member of the College of Fellows of the Society of Manufacturing Engineers, a past member of the SME Board of Directors, including vice president and secretary-treasurer in 1999-2000, and received the SME Joseph A. Siegel Service Award in 2003. His interests include cycling, photography, and industrial archeology. He is a member of ASEE, ASME, the Engineers Club of the Lehigh Valley, SME, and Sigma Xi.

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